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$\text{Al}_{0.2}\text{Ga}_{0.8}\text{As}$ layer was evaluated by means of PL mapping using a secondary harmonics YAG laser. Specifically, the monitoring wavelength was 1080 nm equal to the peak wavelength of the PL light of the $\text{In}_{0.22}\text{Ga}_{0.8}\text{As}$ layer. The laser spot diameter was approximately 30 μm . The measurement point spacing was 10 μm . The scanned measurement region was 2×2 mm. Under these conditions, the peak intensity was mapped. The result of the PL mapping has revealed the presence of dark lines in two directions approximately perpendicular to each other. The dark lines in one direction were of line shape, whereas the dark lines in the other direction were of line segment shape. No dark spot was found. The counted number of dark lines was 26, thereby having given the misfit dislocation density of 650 cm^{-2} .

After that, in order to investigate the PL from the $\text{Al}_{0.2}\text{Ga}_{0.8}\text{As}/\text{GaAs}$ superlattice buffer layer, the intensity mapping was carried out with a monitoring wavelength of 840 nm equal to the PL peak wavelength of GaAs layer. The result has revealed the presence of dark lines in a pattern and a number similar to those of the $\text{In}_{0.22}\text{Ga}_{0.8}\text{As}$ mapping.

Referential Example 2

A HEMT structure was grown under a condition similar to that of Referential Example 1 except for the change in the In composition from 0.22 to 0.2. The presence of misfit dislocations caused by the lattice mismatch between the

$\text{In}_{0.2}\text{Ga}_{0.8}\text{As}$ layer and each adjacent $\text{Al}_{0.2}\text{Ga}_{0.8}\text{As}$ layer was evaluated by means of PL mapping using a secondary harmonics YAG laser. Specifically, the monitoring wavelength was 1050 nm equal to the peak wavelength of the PL light of the $\text{In}_{0.2}\text{Ga}_{0.8}\text{As}$ layer. The laser spot diameter was approximately 30 μm . The measurement point spacing was 10 μm . The scanned measurement region was $2 \times 2 \text{ mm}$. Under these conditions, the peak intensity was mapped. The result of the PL mapping has revealed the absence of dark lines and the presence of dark spots alone. The number of dark spots was 19, thereby having given the dislocation density of 475 cm^{-2} .

After that, in order to investigate the PL from the $\text{Al}_{0.2}\text{Ga}_{0.8}\text{As}/\text{GaAs}$ superlattice, the intensity mapping was carried out with a monitoring wavelength of 840 nm equal to the PL peak wavelength of GaAs layer. The result has revealed the absence of dark lines and the presence of dark spots alone, similarly to the case of $\text{In}_{0.2}\text{Ga}_{0.8}\text{As}$ mapping. The number of dark spots was 103, thereby having given the dislocation density of 2575 cm^{-2} .

The method of measurement of dislocation density permits nondestructive, rapid, and easy measurement of the dislocation density in an epitaxial crystal layers, in a wide range of dislocation density from low to high.

If the structure of the 3-5 group compound semiconductor

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of the present invention is used, the dislocation density in epitaxial crystal layers can be reduced significantly lower than the dislocation density of a GaAs substrate. If a layer structure which can be utilized for electronic devices or optical devices is grown on the buffer layer of the present invention, a device excellent in properties manifesting no influence by dislocation can be produced, namely, such constitution is significantly valuable industrially. Further, when the buffer layers and epitaxial crystal layers of the present invention is used, an epitaxial crystal layers of lower dislocation density can be produced even on a GaAs substrate with high dislocation density, consequently, a device excellent in properties can be obtained, to increase the degree of freedom in selecting substrates. Namely, this epitaxial film has a remarkably large industrial value.